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Ajdukiewicz on justifying the laws of logic

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Abstract The issue of the justification of the laws of logic has been under discussion since the end of the nineteenth century. However, in many works devoted to this problem Ajdukiewicz's achievements are left unmentioned. It can be shown that in certain periods of the development of his views, he tried to present various attempts at solving the problem of the justification of the laws of logic.

Keywords Ajdukiewicz · Justification of deduction · Empiricism · Conventionalism

1. The problem of the justification of the rules of deductive reasoning (and consequently the laws of logic) has been widely discussed since the beginnings of logic and continues to be.[1] In modern logic, the problem of the possibility or impossibility of justifying the rules of deduction is called the 'logocentric predicament'. Hanna (Hanna 2006, pp. 53–75) interprets the logocentric predicament as the thesis that "logic is epistemically circular in the sense that any attempt to explain or justify logic must presuppose and use some or all of the very logical principles and concepts that it aims to explain or justify" (Hanna 2006, p. 55). In

[1] Aristotle noticed the impossibility of justifying all the laws of logic in his extensive considerations of the principle of non-contradiction in his *Metaphysics* (1005b–1009, 1011b–1012a), where he indicates that the principle of non-contradiction cannot be proven: "a principle which everyone must have who understands anything that is, is not a hypothesis; and that which everyone must know who knows anything, he must already have when he comes to a special study. Evidently then such a principle is the most certain of all.' (*Metaphysics*, 1005b, translated by W. D. Ross).

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other words, non-circular argumentation for the validation of the laws and rules of logic is impossible.

Hanna shows the turning points within the discussion of the validation of logic. The issue originates with Caroll, who argues that the attempt to establish a list of conditions necessary to carry out a logically valid argument leads to an infinite regress. Conventionalism, coming from Carnap's *The Logical Syntax of Language*, was supposed to remove the difficulty by shifting the considerations exclusively to the sphere of syntactical meaning conventions. However, according to Hanna, Quine criticized that claim (Quine 1936/1966) showing that to "define logical truth on the basis of syntactical metalogical conventions alone is viciously circular because logic is required to generate the truth from convention" (Hanna 2005, p. 54). At nearly the same time, Gentzen proposed a rule-based approach to logic, arguing "that the meanings of logical constants are strictly determined by the arbitrary metalogical adoption of rules of inference for sentences in which those constants occur as constituents" (Hanna 2005, p. 54). This form of argument was reduced to absurdity by A. N. Prior, who showed that to determine the meaning of operators you still need an additional factor by which to specify an interpretative key binding the meaning of operators with language and thus with reasoning. And finally, Haack presented a very stringent argument showing the impossibility of formulating a good justification of the rules of reasoning.[2]

Hanna also presents different positions on the logocentric predicament:

(a) Logical prudentialism (L. Carroll), according to which logic, despite being groundless, is worth using thanks to the fact that it is useful in improving the efficiency of communication and thinking;
(b) Logical communitarianism (late Wittgenstein) according to which "an acceptance of the groundlessness of logic forces us to recognize that logic, like all human institutions, is based (…) on a mass of more or less coordinated desires and decisions, (…) adopted social conventions" (Hanna 2006, pp. 69–70).
(c) Logical nonfactualism (C. Wright), as a combination of logical prudentialism and logical communitarianism according which logic is essentially normative and practical, but not cognitive;
(d) Semantic and epistemic holism about logic (Quine, Goodman). "According to this view, the groundlessness of logic is a direct consequence of the deeper dual fact that the nature of logic (a) is determined by our whole conceptual scheme and (b) consists in the coherence (…) of all the individual members of the total web of concepts and beliefs, including logical beliefs, non-logical natural scientific beliefs, and empirical beliefs." (Hanna 2006, p. 70).
(e) Logical instrumentalism or pragmatism (Putnam, Haack).Logic generates the logocentric predicament. Logic is an empirical theory whose character is determined by human interests and it is revisable by experience.[3]

[2] (1) All justification is either non-deductive (e.g., inductive) or deductive; (2) on the one hand, a non-deductive justification of deduction is too weak and on the other hand a deductive justification of deduction is circular; therefore, (3) deduction can not be justified (Haack 1976/2011, p. 149).

[3] According to Hanna, logical prudentialism, communitarianism, expressivism, and pragmatism are treated as "forms of scientific naturalism about logic in that they assert (…) the logically strong

Hanna adds one more position that, in his opinion, is free of the logocentric predicament. This position is logical cognitivism, according to which "logic is not groundless at all, because despite its epistemic circularity it nevertheless has a legitimate explanation and justification in the logic faculty-thesis (…) To acknowledge the predicament while rejecting the groundlessness of logic is to affirm logical cognitivism" (Hanna 2006, p. 55).

Do we really have to agree to the dilemma: logocentric predicament versus cognitivist perspective? Ajdukiewicz's many achievements show that the justification of the laws of logic played an important role in his work. How does the development of his ideas relate to the history of the twentieth century discussion about the foundation of logic? I turn now to the examination of the evolution of Ajdukiewicz's views on the validity of the laws of logic and methods of reasoning.

2. "Each rule of logic, identifying a certain way of reasoning as valid, is based on a logical statement which asserts a certain objective state of affairs. Learning the logic, we not only develop in the art of logical thinking, but also get to know certain relationships between facts constituting the logical structure of the world, we get to know the logic of things." (Ajdukiewicz 1953, pp. 5–6).

This claim comes from the textbook which Ajdukiewicz published in 1953. Should one take it as seriously as indicated by numerous authors—many of Ajdukiewicz's findings appeared in his textbooks (he did not treat his didactic work less seriously)—one must accept the fact that the statements of logic are of an objective character, that is, they are statements about reality and not only terminological conventions. It may seem that such a claim like this is strange coming from the author of radical conventionalism.

Ajdukiewicz's views on language (and consequently sentence analysis and the laws of logic) changed. Three phases of the development of these ideas have been distinguished: radical conventionalism, moderate empiricism, and extreme empiricism.[4] At the core of radical conventionalism there is a directive-based conception of language, according to which the meaning of the word of a language is constituted by three types of directives (rules): deductive, axiomatic, and empirical.[5] "The deductive rule of meaning correlates with a class of sentences of certain types (as premises) a sentence of another definite type (as conclusion)." The rule of modus ponens is an example of a deductive rule as, "only that person who connects with an expression of the English language the meaning coordinated with it in that language is prepared to accept the sentence B as soon as he accepts sentences of the

Footnote 3 continued
supervenience of logic on the natural facts. But scientific naturalism about logic is self-refuting." Another objection is "that none of them adequately explains our intuition that logical discourse is (…), obvious, actually or potentially" (Hanna 2006, p. 71).

[4] Ajdukiewicz describes the change of his semiotic views in Ajdukiewicz 1964/1978.

[5] Meaning determines the rules of meaning, and not vice versa: "The rules of meaning of a language, requiring of each user of the language to accept certain sentences of this language in certain situations, are thus determined by the meaning of the words and the expressions of the language. Whoever violates these rules of meaning shows thereby that he does not attach to the word-sounds of the given language the meaning coordinated with them in this language; and therefore that he is not using this language, but some other one." (Ajdukiewicz 1934a/1978, p. 44).

form, if A, then B and A (Ajdukiewicz 1934a/1978, p. 45). The axiomatic rule of meaning is a rule requiring an unconditional recognition of certain sentences; "an axiomatic rule of meaning determines a unique characteristic set of sentences, viz. precisely those sentences whose acceptance is enjoined by the axiomatic rule of meaning" (Ajdukiewicz 1934a/1978, p. 46). For example, anyone who knows the meaning of the words 'every' and 'is' must accept the sentence 'Every A is A'. Finally, an empirical rule of meaning "… is characterized by the fact that the situations it involves consist either exclusively or partly in experiencing a perception" (Ajdukiewicz 1934a/1978, p. 46).

Radical conventionalism can be summarized in the form of Ajdukiewicz's thesis: "of all the judgments which we accept and which accordingly constitute our entire world-picture none is unambiguously determined by experimental data; every one of them depends on the conceptual apparatus we choose to use in representing experimental data. We can choose, however, one or another conceptual apparatus which will affect our whole world-picture." (Ajdukiewicz 1934b/1978, p. 67) The conceptual apparatus is determined by the semantic rules of language; that is why in every language the conceptual apparatus may vary. One can thus expect that both deductive and axiomatic rules of various languages may differ and therefore the logical constants may be otherwise specified and the laws of logic and deduction rules in each language may differ. And indeed such a view can be found in Ajdukiewicz's work. The laws of logic are valid only for a given language (conceptual apparatus) and may change when the conceptual apparatus is changed (Woleński 1985, p. 195).[6] Moreover, it is impossible to formulate a universal language and, accordingly, a universal logic; it would be a disconnected language because "a universe of meaning which corresponds to a disconnected language would comprise judgments which fall into various universes having between them no logical relations at all."[7] In other words, since each language through its axiomatic and deductive rules determines its own logic, a universal language combining multiple languages "would have to combine multiple logics, these logics

[6] The same applies to the truthfulness of scientific statements from the perspective of radical conventionalism: "The basic epistemological function, which is the assertion of these or other opinions, is always carried out within the established conceptual apparatus, and change of apparatus also changes the set of recognized sentences." (Woleński 1985, p. 196) As Woleński indicates, that view is similar to Carnap's thesis called the principle of tolerance, according to which: "It is not our business to set up prohibitions, but to arrive at conventions. (…) In logic, there are no morals. Everyone is at liberty to build up his own logic, i.e. his own form of language, as he wishes. All that is required of him is that, if he wishes to discuss it, he must state his methods clearly, and give syntactical rules instead of philosophical arguments." (Carnap 1937/2001, pp. 51–52).

[7] Ajdukiewicz refers here to his notions of open and closed languages, and coherent and incoherent languages. A language is open when it can incorporate new expressions that are non-synonymous to other expressions already occurring in this language, which together with the existing expressions produce new meanings—otherwise a language is closed, which means that the addition of a new expression shows that it has the same meaning as an expression in the language, that expression constitutes an isolated element of the language. On the other hand a language is coherent, if two expressions of the language are linked semantically (Ajdukiewicz 1934a/1978, pp. 50–53); Ajdukiewicz considered only closed and consistent languages as valuable - hence in the aforementioned argument a universal language would not have value. As Ajdukiewicz pointed out in a later article, published after his death, he abandoned the concept of languages that are closed and consistent stating that there are no such languages - the concept of a closed and consistent language is empty (Ajdukiewicz 1953, p. 176).

would have no relation to one another, and each would apply to a different universe of sentences provided there were logical formulas for each universe of sentences" (Ajdukiewicz 1934b/1978, p. 80).

It seems that Ajdukiewicz's point is that, because meaning is an internal matter of a given language, creating a universal language would have to rely on combining a number of languages, each of which has its own axiomatic and deductive rules. Thus a situation in which the same expressions could be governed by different rules of meaning is possible, and that would in consequence lead to ambiguities and contradictions—hence the inconsistency of a universal language. How then can we deal with the truth of the laws of logic? The conception in question was formulated, as has been pointed out, before Tarski presented the possibility of using the notion of truth free from antinomy.[8] Therefore, in that conception the justification of the laws of logic comes only from the meaning rules of the language; the laws of logic are then of a strict a priori character, but still they cannot be regarded, as neo-positivists claimed, as empty tautologies, devoid of meaning.[9] Ajdukiewicz makes it clear that a priori knowledge exists, and it presents reality (e.g. that every A is A), but actually its source is the meaning of the relevant words in a language.[10] In that sense, the choice of the conceptual apparatus precedes experience and establishes the truthfulness of a given law of logic—in a different conceptual apparatus imposing a different meaning of expressions a different logic may hold.[11]

This conclusion seems to be consistent with Carnap's conventionalism; the importance of expressions of the calculus is determined by a free choice of conditions imposed on the rules of the transformation of symbols. "'So logical meaning derives from a source outside of logic itself."' (Hanna 2006, p. 61)

[8] In 1953, in response to allegations of A. Schaff, Ajdukiewicz states: "'In my pre-war work I consciously and deliberately did not consider the questions, if whether sentences acceptable according to the rules of language have guaranteed accuracy. (…). In my paper *Das Weltbild und die Begriffsapparatur* (…) I explicitly declared that I do not wish to consider the issue of the truthfulness of the image of the world (…) because of the antinomies, which relate to the attribute "true". (…) I have never claimed that every axiom is true, although I claimed that for every axiom I state its truthfulness. This is a major difference between the claim that every axiom is true, and the claim that I state the truthfulness of every axiom. The first claim refers to the truthfulness of axioms, the other one concerns only my activity. Only if I could take credit for infallibility, I would have the right to derive the first claim from the second of these claims to derive the first one."' (Ajdukiewicz 1953/1985 vol. 2, p. 162).

[9] In his view, the origin of treating *a priori* sentences as worthless tautologies is the recognition that only empirically tested sentences have cognitive value. Neopositivists claim that "knowledge about reality can be acquired only by experience. (…) The truthfulness of that [*a priori* - ML] sentence will be maintained irrespective of reality, therefore, the sentence does not say anything about reality" (Ajdukiewicz 1946/1985b, p. 9).

[10] One may ask what is the source of the fact that *a priori* language rules of meaning determine that what follows from them is the knowledge of the world, and not a set of empty algorithms? Ajdukiewicz does not take up that question. This is due to the fact that Ajdukiewicz was not interested in the origins of language, but in language as a product. The matter of the user (creator) of language is ignored: it is, according to Woleński, "'an autonomous conception of language,"' as language is treated as independent of the user—"'the user, in order to speak or write properly, must respect the rules of meaning dictating the meaning"' (Woleński 1985, p. 192).

[11] "'I believed that the axioms of logic are determined by the language which we use and the choice of a language (…) must precede any experience. I believed, for example, that one cannot expect experience to decide whether the law of contradiction (…) is true"' (Ajdukiewicz 1964/1978, p. 316).

However, Carnap's conventionalism applied to the laws of logic was criticized by Quine, according to whom conventions are general and therefore need logic in order to be applied. It is impossible to apply conventions as the basis of logic without establishing and applying a logic which is not constituted by conventions itself.[12] This must lead to the circularity of the justification of logic (and is similar to the formulation of the problem of the circularity of justification given by Lewis Carroll). What distinguishes Ajdukiewicz of that period from Quine is the fact that Ajdukiewicz does not pose the question of the justification of the laws of logic, but only discusses their character, namely, whether they are determined by the meaning of the connectives that appear in them.

3. The development of Ajdukiewicz's views led him to consider language (and therefore the laws of logic) empirically. In Ajdukiewicz 1947/1978 he discussed the possibility of an empirical justification for the laws of logic. The starting point of the analysis is the observation that "… appeal to experience is used by some in order to attack the laws of logic established by age-long tradition, such as the law of non-contradiction or the law of excluded middle. According to others, experience is to decide the choice of one or other of the numerous many-valued logics which can be construed. It might seem that these empiricist claims are mere illusions, and that the sanctions from which the laws of logics derive their right to the status of scientific statements are entirely different from the test of experience" (Ajdukiewicz 1947/1978, p. 164). Ajdukiewicz starts from the division of empirical sentences into sentences based directly and indirectly on experience. The former are perceptual sentences, while the latter are "… (1) hypotheses verified by experience, (2) non-perceptual sentences derived by deduction either from perceptual sentences or from verified hypotheses or from both" (Ajdukiewicz 1947/1978, p. 166). Thus, sentences based indirectly on experience are derived from perceptual sentences with the use of the laws of logic. The question of the status of the laws of logic is important here. Ajdukiewicz attempts to prove that it is possible to provide an argumentation free of *petitio principii* for the thesis that the same laws of logic themselves may be justified as verified hypotheses.[13] This argument can be summarized as follows:

(a) The laws of logic can be understood as language statements (logical statements) or as rules of inference. Logical theorems can be treated as scientific statements (like any other of scientific statements), while rules belong to metascience (e.g. methodology of science). Extreme empiricism requires empirical justification for the laws of logic treated as statements of the language of a given science.

[12] "The point is that the logical truths, being infinite in number, must be given by general conventions rather than singly; and logic is needed then to begin with, in the metatheory, in order to apply the general conventions to individual cases." (Quine 1954/1956, p. 108).

[13] It is interesting that in the published version of Ajdukiewicz's article in *Synthese* (Ajdukiewicz 1949–1951) the second part of the article, which contains the arguments presented here, omits the empirical justification of the laws of logic.

(b) Logical theorems can serve as premises and conclusions in deduction or as principles of deduction. The first role is most common within logic itself, while in the second role a logical theorem comes into play when some inference in the field of objective knowledge is performed according to it (e.g. an inference in zoology performed on the basis of the syllogism Barbara).

(c) A theorem is accepted as a proven hypothesis if a deduction has been carried out where each step can refer to a certain logical statement as its principle.

(d) The verification of a hypothesis takes place in a reductive reasoning, that is, an inference in which we derive the hypothesis from protocol statements. "A reductive argument consists in the acceptance of a hypothesis H on the basis of the acceptance of perceptual sentences S and of some additional assumptions Z, provided that these perceptual sentences S have been deduced in virtue of the rules of logic from the conjunction of H and Z, and none of the deduced sentences turned out to be in conflict with any accepted perceptual sentence." (Ajdukiewicz 1947/1978, p. 170) According to Ajdukiewicz, the laws of logic can also be justified by reductive argument. For one to have reductively inferred a law of logic L as a hypothesis, he should first derive a perceptual sentence from that law and assumptions Z by deduction, and then from the sentences S and Z infer L.

(e) The reductive reasoning described above is free from an overt *petitio principii* since none of its premises (perceptual statements and additional assumptions) is a law of logic. Neither does a reductive justification for the laws of logic contain a disguised *petitio principii* (circularity). A reductive argument from the acceptance of sentences S and Z to the acceptance of L is correct if, firstly, sentence S had been previously deduced in accordance with the laws of logic from L and Z and, secondly, if none of the deduced sentences contradicts any already accepted perceptual sentence. According to Ajdukiewicz, the source of the objection concerning the apparent vicious circle lies in the mistaken belief:

> … that in order to effect valid deduction it is necessary to accept in advance those logical tautologies which constitute the (logical) form of deduction. This is not so, however. In order to deduce a sentence B from another sentence A in conformity with the laws of logic it is necessary and sufficient that for every step of the deductive chain there exists a logical tautology which is its principal basis (…). This is enough to effect the deduction. It is not necessary to be familiar with the logical tautology in question, nor is it necessary to know that one's inference conforms to it. It is enough that the inference does in fact conform to it. The charge of implicit circularity, viz. the claim that in order to infer correctly by reductive argument the law L from perceptual sentences S and assumption Z one would have first to accept the logical law L, is not justified in this case. The illusion that it is justified originates from the mistaken belief that to perform any deduction it is necessary to accept in advance suitable laws of logic. (Ajdukiewicz 1947/1978, p. 170–171)

Indeed, the aforementioned argument avoids the circularity of justification at the language level by separating subject knowledge from meta–subject knowledge.[14] Moreover, according to Ajdukiewicz, for the correctness of inference it is enough for the laws of logic, regarded as rules of inference, to operate as tacit mechanisms governing inference, not as the beliefs of the person making the inference. In this way, the person performs an inference without realizing that they know those rules of inference.

The above-mentioned argument in favour of accepting the laws of logic as sentences indirectly based on experience does not provide the justification for the laws of logic as rules of inference (Woleński 1985, p. 201). Moreover, Jedynak claims that in seeking to avoid a vicious circle in justifying the laws of logic Ajdukiewicz fell into contradiction.

> Since we require the premises in reasoning to be not only true but also duly justified, we may likewise require the same rules to be not only accurate, but also (…) intentionally accepted as unfailing. If so, then, for the correctness of reasoning, it is not enough to follow the laws of logic, but one also needs to know that one is proceeding according to them. For if not, then how can you check empirically the laws of logic, including scientific hypotheses, since you are not aware of the laws which allow for deriving observational consequences from the hypothesis? To avoid falling into a vicious circle in deriving the consequences of the hypothesis one should only apply the directives based on laws of logic while deriving consequences from hypotheses, without knowing them [these laws], but on the other hand, in order to justify these laws empirically as shown one should know them. (Jedynak 2007, p. 58)

Are we really in a deadlock here? Before attempting to answer the question let's take a look at the Haack's argument mentioned at the beginning of the article against the possibility of the justification of deductive inference rules.

Haack analyzes several arguments for the circularity of the justification of deduction. The first argument refers to a simple circularity, viz., while justifying a rule you must refer to the same rule. Moreover, the circularity of the argument may be supported by the example according to which a rule which is not based on a law of logic, and therefore not valid, has a justification analogous to modus ponendo ponens.[15] Another way to validate modus ponens is such that an analogous justification was not possible for modus morons. "Caroll's tortoise refuses to draw the conclusion "B" from "$A \supset B$" and "A", insisting the new premiss "$A \supset ((A \supset B) \supset B)$" be added; and when that premiss is granted him, he will still not draw the conclusion, but insists on a further premiss, and so *ad infinitum*.' (Haack 1976/2001, p. 156) Then one can show the difference between the argument for modus ponens (by adding, following the tortoise, the above true but superfluous

[14] By subject knowledge we mean knowledge about states of affairs and by meta-subject knowledge we mean higher level knowledge; for example, logic is subject knowledge and metalogic is meta-subject knowledge.

[15] We can provide the deductively invalid rule modus morons: From $A \supset B$ and B, to infer A. Now, there is the following argument: 'Suppose D ("$A \supset B$" is true, "B" is true). If C, then, D (if "A" is true, then, if "$A \supset B$" is true, "B" is true). So, C ("A" is true).' (Haack 1976/2001, p. 155).

premiss) and the argument for modus morons (which requires the false but needed premiss: '$B \supset ((A \supset B) \supset B)$'. However, as Haack shows, that expedient does not help, because the argument for modus morons can be based, like that for modus ponens, on the true but superfluous premiss ($(A \supset B) \supset (A \supset B)$). Still, a different argument refers to the fact that the justification of modus ponens, unlike modus morons, refers to the meaning of '$\supset$'. The meaning of an operator can be defined by the axioms and rules of inference of the system, through interpretation, such as a truth-table or by English readings of the operators. The meaning of operators can also be specified using the rules of joining-omitting operators. That last instance, however, that is, a purely formal attempt to determine the behaviour of an operator, leads to the difficulties noted by A. N. Prior and then generalized by N. Belnap. Following the idea of Prior, Haack shows that modus morons can lead to contradictions (Haack 1976/2011, p. 158).[16]

The conclusion coming from the attempts presented here to justify deductive rules is that none of them is successful; deductive justification of deductive rules seems to be impossible. That leaves two possibilities with which Ajdukiewicz struggled. One (from the period of his radical conventionalism) is to leave deductive rules and laws of logic analogous to the rule without, so to speak, an extra-linguistic justification; as regularities determined by the meaning-rules of a language they can change together with the changes of languages. The second possibility (empiricism) is to look for the justification of the laws of logic (deductive rules) beyond language. One such attempt was to justify the laws of logic as sentences indirectly based on experience (Ajdukiewicz 1947). Here laws find their justification at the expense of unjustified rules. Does Ajdukiewicz, as Jedynak suggested, fall into contradiction? Not necessarily. It is rather that he eventually falls into circularity or he must adopt some other justification of rules. Looking at the second option it could be that in fact a rule has as its principle a law of logic, the person deducing does not know that law and uses the rule as belonging to his 'scientific equipment' or as an innate rule. Then we have the cognitive solution proposed by Hanna (logical cognitivism). There is also another way toward which Ajdukiewicz seemed to be heading, recognizing the possibility of languages devoid of both axiomatic and deductive rules of meaning,[17] namely to find the basis for the laws of logic in the regularities of the world.

A cognitive solution recognizes the impossibility of the internal removal of the logocentric predicament. Various attempts at a cognitive justification in the form of postulating the existence of a logical faculty in man are suggested instead; man as a *zoon logikon* is equipped with the logical faculty, differently understood. This could be, for example, some protologic (Hanna 2006) or logical competence (Macnamara 1986) analogous to linguistic competence. In Macnamara's conception the bases for deductive rules are constituted by logical competences associated with language

[16] However that way of disqualification of modus morons is unsatisfactory, because it is based on numerous assumptions about the system in which modus morons appears.

[17] Ajdukiewicz first proposed a language without axiomatic rules, then noticed that heading towards extreme empiricism we should also remove deductive rules. As noted by Woleński, removing axiomatic rules when facing claims of deduction does not deprive the language of logical axioms, because every logical rule can be transformed into an implication rule (the laws of logic are the consequences of the empty set) by a repeated application of the deduction theorem (Woleński 1985, p. 201).

competences, manifested as 'devices to draw inferences', called by him implicators (Macnamara 1986, pp. 37–42).[18] At the same time it is important that logical knowledge assumes the form of those devices (mechanisms) and not in the form of logical beliefs (a child possesses mechanisms to carry out deduction although does not know any sentences which are the laws of logic). Ajdukiewicz's intuition that a scientist uses logical rules without knowing them could therefore be interpreted in the spirit of cognitivism.

The second way seems to be expressed in the above-cited fragment from *Zarys logiki (An Outline of Logic).* "Every principle of logic, defining a way of reasoning as valid, is based on a logical statement which identifies a certain objective relationship between states of affairs." (Ajdukiewicz 1953, p. 5) The sequence of actions justifying the deduction is then reversed: logical statements, identifying the objective relationship between states of affairs, are primary, and the rules are justified on the basis of logical claims. In that sense, logical statements have an ontological character. "Classical logic examines, identifies such objective relationships between the facts which are discussed in all sciences of an ontological character. (…) They are relationships concerning the occurrence and non-occurrence of a fact in the case of one fact, relationships concerning the co-occurrence of two facts, regardless of the time and place of their occurrence." (Kiczuk 1995, p. 50) If we were to leave only the empirical rules of the meaning of a language (Ajdukiewicz did not manage to elaborate on that conception), language at the starting point would be deprived of the logical rules and consequently of the laws of logic—it would have to acquire them solely from experience, just as the natural sciences do, recognizing regularities occurring in the world.

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[18] One of the sources of logical cognitivism is Fodor's conception of the language of thought, in which it is assumed that linguistic competence is innate; Macnamara clearly refers both to Fodor's conception and Chomsky's conceptions of generative grammars (Macnamara 1986, Chapter II).

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